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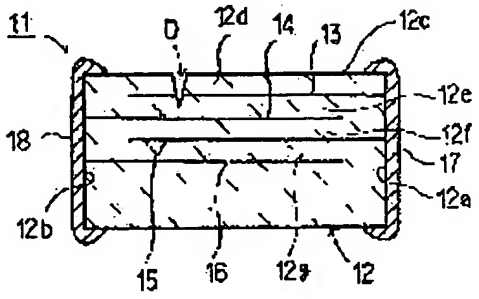
(54) MULTILAYER CERAMIC ELECTRONIC COMPONENT

(57)Abstract:

PURPOSE: To obtain a multilayer a ceramic electronic component having such structure as allowing easy and positive trimming of capacitance through irradiation with laser beam.

CONSTITUTION: The multilayer ceramic electronic component where the outermost inner electrode is trimmed through irradiation with laser beam includes a plurality of inner electrodes 13-16 formed in a sintered dielectric ceramic 12 through ceramic layers while being overlapped each other. The outer ceramic layer 12d of the outermost inner electrode 13 has a thickness being set equal to or thinner than 1.5 times that of ceramic layers 12e-12q interposed between the inner electrodes 13-16.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the laminating ceramic electronic parts with which the structure for adjusting electrostatic capacity especially was improved about the laminating ceramic electronic parts which have two or more internal electrodes for constituting a capacitor.
[0002]
[Description of the Prior Art] In the ceramic multilayer substrate having a multilayer capacitor or a capacitor, in order to adjust electrostatic capacity, various approaches are tried from before. The method (henceforth trimming) of cutting some internal electrodes and changing area by irradiating laser light, especially, as one of the approaches which adjusts electrostatic capacity after producing a multilayer capacitor and a ceramic multilayer substrate, is learned widely.
[0003] The process which adjusts electrostatic capacity by the exposure of laser light as mentioned above is explained with reference to drawing 5 . The multilayer capacitor 1 shown in drawing 5 has the ceramic sintered compact 2 which consists of dielectric ceramics. Inside the ceramic sintered compact 2, it is arranged so that two or more internal electrodes 3-6 may overlap through a ceramic layer. Internal electrodes 3 and 5 are electrically connected to the external electrode 7 of the ceramic sintered compact 2 which is pulled out by the end face on the other hand, and was formed in this one side end face. Similarly, internal electrodes 4 and 6 are pulled out by the another side end face of the ceramic sintered compact 2, and are electrically connected to the external electrode 8 formed in this another side end face.
[0004] Adjustment of electrostatic capacity was performed by irradiating laser light from the top-face 2a side of a sintered compact 2, after obtaining the above-mentioned multilayer capacitor 1. That is, as a broken line A showed, for example, some internal electrodes 3 were cut and electrostatic capacity was adjusted so that desired electrostatic capacity could be realized.
[0005]
[Problem(s) to be Solved by the Invention] However, in the multilayer capacitor 1, thickness of upper ceramic layer 2b was made quite thicker than an internal electrode 3 compared with the thickness of about 100-200 micrometers and the ceramic layer between internal electrodes 3-6. Therefore, in fact, even if it irradiated laser light, a laser beam might not reach to the part in which the internal electrode 3 is formed as an arrow head B shows, or as an arrow head C showed, even two or more internal electrodes 3-6 might be reached, and adjustment of electrostatic capacity made into the purpose might not be completed.
[0006] Therefore, if the exposure reinforcement and irradiation time of laser light were not controlled with high precision on the occasion of the trimming by the exposure of the above laser light, even if it could not adjust the target electrostatic capacity but controlled laser luminous intensity and irradiation time with high precision, it was very difficult to cut certainly only the above-mentioned ceramic layer 2b of a very small multilayer capacitor by laser.
[0007] The purpose of this invention is to offer laminating ceramic electronic parts equipped with the

structure which makes it possible easily and to ensure adjustment of the electrostatic capacity by the exposure of laser light.

[0008]

[Means for Solving the Problem] This invention is equipped with the dielectric ceramics and two or more internal electrodes arranged so that it may overlap through a ceramic layer in said dielectric ceramics. In the laminating ceramic electronic parts with which electrostatic capacity is adjusted by irradiating laser light among said two or more internal electrodes at least at one side of the internal electrode of the outermost layer The thickness of the ceramic layer of the outside of one [at least] internal electrode is the laminating ceramic electronic parts characterized by considering as 1.5 or less times of the thickness of the ceramic layer between internal electrodes among the internal electrodes of said outermost layer.

[0009]

[Function] Let so greatly, i.e., as mentioned above, thickness of the ceramic layer of the outside of one [at least] internal electrode be 1.5 or less-time thickness to the thickness of the ceramic layer between internal electrodes in the laminating ceramic electronic parts of this invention among the internal electrodes located in the outermost layer. Therefore, since the cutting depth becomes shallow, the dispersion becomes small and adjustment of electrostatic capacity, such as a multilayer capacitor and the capacitor section of a ceramic multilayer substrate, can be ensured.

[0010]

[Example] Hereafter, this invention is clarified by explaining an example, referring to a drawing.

[0011] Drawing 1 is the sectional view showing the multilayer capacitor concerning one example of this invention. A multilayer capacitor 11 has the sintered compact 12 which consists of dielectric ceramics. In the ceramic sintered compact 12, it is arranged so that two or more internal electrodes 13-16 may overlap through a ceramic layer. Internal electrodes 13 and 15 are electrically connected to the external electrode 17 of the ceramic sintered compact 12 which is pulled out by the end face on the other hand, and was formed in this one side end face. Internal electrodes 14 and 16 are pulled out by another side end-face 12b of the ceramic sintered compact 12, and are electrically connected to the external electrode 18 formed in this another side end-face 12b.

[0012] When the multilayer capacitor 11 of this example irradiates laser light from the top-face 12c side of a sintered compact 12, adjusting electrostatic capacity is planned. And the thickness of 12d of 12d of ceramic layers of the outermost layer of the side by which the above-mentioned laser light is irradiated, i.e., the ceramic layer located outside an internal electrode 13, has the description of a multilayer capacitor 11 in being constituted so that it may have 1.5 or less times [of the ceramic layers 12e-12g between internal electrodes 13-16] thickness.

[0013] By considering as 1.5 or less times of the thickness whose thickness of 12d of ceramic layers is the ceramic layers 12e-12g as mentioned above, as an arrow head D shows by the exposure of laser light, even the part in which the internal electrode 13 is formed can be cut certainly, and it can adjust electrostatic capacity certainly.

[0014] In addition, as mentioned above, the thickness of 12d of ceramic layers is the following, and, specifically, is made and determined. It is dispersion in Bar x (micrometer) and the depth of cutting about the average of the cutting depth by the exposure of now and laser light [0015]

[Equation 1]

$\hat{\sigma}$ (μm)

但し、以下$\hat{\sigma}$をσと略記する。

[0016] It is [0017] when it carries out.

[Equation 2]

$\hat{\sigma} = 0.085\bar{x} + 0.33 \quad \cdots \quad (I)$

[0018] It becomes. a formula (I) -- setting -- 3sigma -- < (a/2) -- it is -- sigma to which sigma does not

exceed thickness a of the ceramic layer between internal electrodes by 99.3% of probability is determined. Therefore, if the value of such sigma is assigned to a formula (I), the average-value bar x of the depth of cutting with which sigma does not exceed thickness a of the ceramic layer between internal electrodes will be called for. Consequently, the thickness of 12d of ceramic layers which can be cut can be determined.

[0019] Therefore, by determining the thickness of 12d of ceramic layers which can be cut based on internal inter-electrode ceramic layers [12e-12g] thickness, and choosing the thickness of 12d of ceramic layers as 1.5 or less times of the thickness which is the ceramic layers 12e-12g as mentioned above, regardless of dispersion in the exposure conditions of laser light, only an internal electrode 13 can be cut certainly and electrostatic capacity can be adjusted with high precision from the above-mentioned formula (I).

[0020] According to the experiment of an invention-in-this-application person, when ceramic layers [between internal electrodes 13-16 / 12e-12g] thickness was 30 micrometers, according to this example, it was confirmed by making thin thickness of 12d of ceramic layers with 45 micrometers or less that an internal electrode 13 can be cut with high precision. In addition, in the considerable conventional example, since thickness of the ceramic layer of the outside of an internal electrode was set to 100-200 micrometers when the thickness of an internal inter-electrode ceramic layer was the same as the above, as mentioned above, electrostatic capacity by the exposure of laser light was not able to be adjusted with high precision.

[0021] Drawing 2 is the sectional view showing the multilayer capacitor concerning the 2nd example of this invention. In the multilayer capacitor 21 of the 2nd example, it is arranged so that the internal electrodes 23-25 of three sheets may overlap through a ceramic layer in the ceramic sintered compact 22. Here, internal electrodes 23 and 25 are connected to the external electrode 27 electrically [an internal electrode 24] to the external electrode 28. A different place from the 1st example has the thickness of upper ceramic layer 22a of an internal electrode 23 in being made thinner than the ceramic layers 22b and 22c between internal electrodes 23-25. That is, the thickness of ceramic layer 22a located outside the internal electrode 23 of the outermost layer may be thinner than the ceramic layers 22b and 22c between internal electrodes 23-25, and can adjust electrostatic capacity certainly and easily by the exposure of laser light like the 1st example also in this case so that clearly also from the 2nd example.

[0022] Drawing 3 is the sectional view showing the multilayer capacitor concerning the 3rd example. In the multilayer capacitor 31 of the 3rd example, a ceramic sintered compact with more thin thickness is used as a ceramic sintered compact 32 compared with the case of the 1st and 2nd example. Also in this case, the exposure of laser light can adjust electrostatic capacity certainly like the 1st and 2nd example to the thickness of the ceramic layers 32b and 32c between internal electrodes 33-35 by making thickness of upper ceramic layer 32a into 1.5 or less times rather than an internal electrode 33.

[0023] Although adjusting electrostatic capacity by irradiating laser light from the top-face side of the ceramic sintered compacts 12, 22, and 32 was planned in the 1st - the 3rd example, you may constitute from laminating ceramic electronic parts of this invention so that it can cut by laser light from which [of the top face of a ceramic sintered compact, and an inferior surface of tongue] side. Drawing 4 is the sectional view showing the multilayer capacitor as an example of such laminating ceramic electronic parts.

[0024] In the multilayer capacitor 41, it is arranged so that internal electrodes 43-48 may overlap through a ceramic layer in the ceramic sintered compact 42. Internal electrodes 43, 45, 46, and 48 are pulled out by the one side end face of the ceramic sintered compact 42, and are electrically connected to the external electrode 49. Internal electrodes 44 and 47 are pulled out by the another side end face of the ceramic sintered compact 42, and are electrically connected to the external electrode 50 in this another side end face.

[0025] In this example, thickness of 42f of ceramic layers located under upper ceramic layer 42a of an internal electrode 43 located most up and the internal electrode 48 located in the method of the lowest is made into 1.5 or less times of the thickness of the ceramic layers 42b, 42c, 42d, and 42e between internal electrodes, respectively.

[0026] Therefore, laser light may be irradiated from which [by the side of the top face of the ceramic sintered compact 42, and an inferior surface of tongue] side, and it can adjust either [at least] an internal electrode 43 or the internal electrode 48 to the target electrostatic-capacity value.
[0027] In addition, although the example mentioned above is applied about a multilayer capacitor, this invention can apply the capacitor sections, such as a ceramic multilayer substrate which has the capacitor section, to the general laminating mold ceramic electronic parts which it has inside.
[0028]
[Effect of the Invention] In this invention, in the laminating ceramic electronic parts which have the part which constitutes the capacitor, since thickness of the ceramic layer located in one [which is located in the outermost layer / at least] outside of an internal electrode is made into 1.5 or less times of the thickness of an internal inter-electrode ceramic layer, laser light can be adjusted to the value aiming at electrostatic capacity easily and certainly by irradiating the internal electrode of the outermost layer.
[0029] Therefore, it becomes possible to reduce sharply the rate of a cutting defective of the laminating ceramic electronic parts which have the capacitor section.

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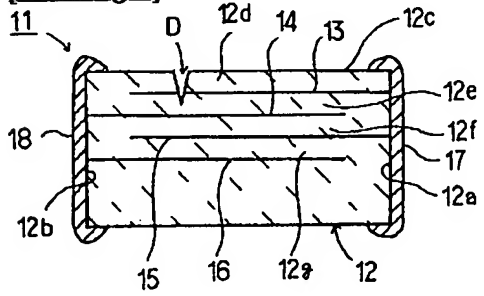
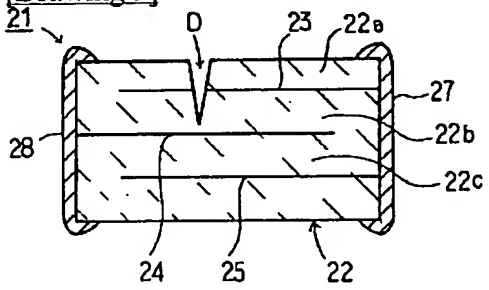
DRAWINGS

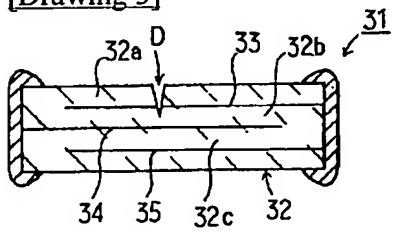
[Drawing 1]



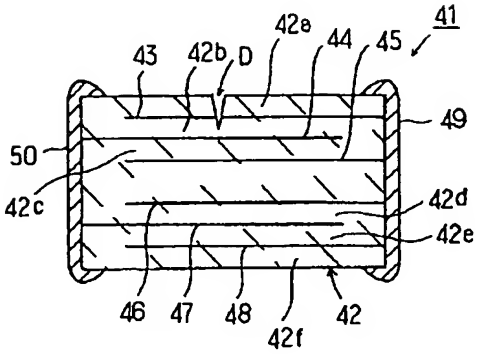
[Drawing 2]



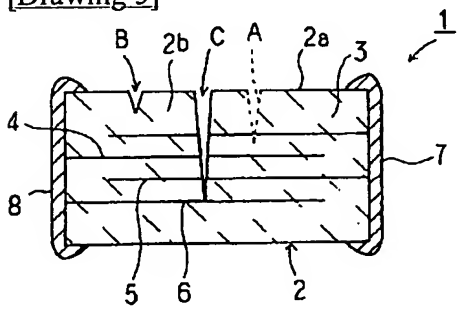
[Drawing 3]



[Drawing 4]



[Drawing 5]



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